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Publication Brief for Resource Managers

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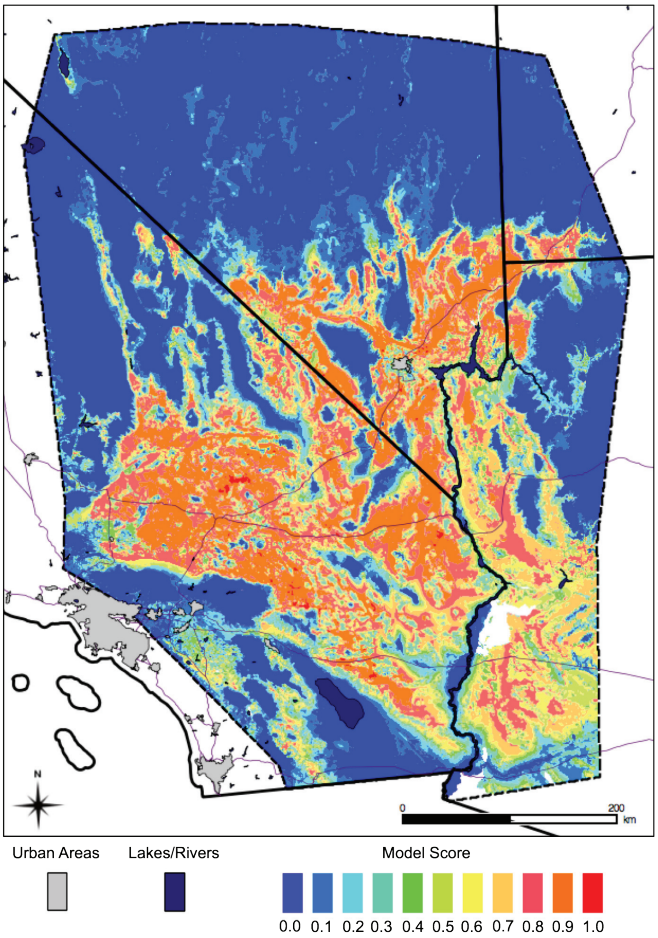
Modeling Potential Habitat of the Desert Tortoise

Habitat modeling is an important tool used to simulate the potential distribution of a species for a variety of basic and applied questions. The desert tortoise *(Gopherus agassizii)* is a federally listed threatened species in the Mojave Desert and parts of the Sonoran Desert of California, Nevada, Utah, and Arizona. Land managers in this region require reliable information about the potential distribution of desert tortoise habitat to plan conservation efforts, guide monitoring activities, monitor changes in the amount and quality of habitat available, minimize and mitigate disturbances, and ultimately to assess the status of the tortoise and its habitat toward recovery of the species. In USGS Open-File Report 2009-1102, an interdisciplinary team of USGS biologists, hydrologists, geologists, and geographers present a robust model that provides output of the statistical probability of habitat potential that can be used to map potential areas of desert tortoise habitat.

Management Implications:

- Land managers can benefit from the use of a predictive habitat model that covers the entire listed range of the Mojave population of desert tortoise.
- This habitat model can highlight areas that have the potential to be habitat that are relatively unknown to previous monitoring efforts.
- Subsequent analyses of the conservation status, connectivity, and future impacts are now possible.



This map shows the spatial representation of the predicted habitat potential index values for desert tortoise in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. Map: USGS.

The scientists developed a quantitative habitat model for the desert tortoise using an extensive set of field-collected presence data for desert tortoises. To produce the habitat suitability model, sixteen environmental data layers were developed that were hypothesized to influence tortoise ecology/habitat potential through a variety of mechanisms. These were generally related to attributes of the landscape physiognomy, properties of the soil, annual rainfall patterns, and biotic influences of perennial and annual plants. Through the modeling process the relative importance of these environmental variables was assessed, and refined to a set of 10 variables that were most important in defining habitat for the desert tortoise.

The Maxent modeling algorithm was used to produce the statistical model describing desert tortoise habitat at 1 square-kilometer resolution. This model provides output in the form of a statistical probability of habitat potential (ranging from 0 to 1) that can be used to map potential areas of desert tortoise habitat. The scientists chose not to create arbitrary cut-offs above and below which habitat is considered as either good or bad for tortoises, but rather to present the model in its semi-continuous form so that land managers can make their own evaluations of thresholds for their particular application. This model was evaluated with independent data that were withheld (20% of the known occurrences) during the modeling process specifically for testing. The model performed very well, with high test scores of 0.93, indicating a substantial agreement between the predicted habitat and the observed localities of desert tortoises.

This model was produced without regard to recent or current human-caused alterations or impacts (such as urban development, habitat destruction, or fragmentation) or natural disturbances (such as fire) to the landscape. Thus this analysis, while robust in its predictions of potential habitat, does not account for recent changes that may have altered habitat with relatively high potential into areas with lower potential in recent years. Examination of the prevalence and consequences of these types of alterations are the subject of ongoing research.

The open-file report and model are available digitally at the following web page.
http://pubs.usgs.gov/of/2009/1102/

Nussear, K.E., Esque, T.C., Inman, R.D., Gass, Leila, Thomas, K.A., Wallace, C.S.A., Blainey, J.B., Miller, D.M., and Webb, R.H. 2009. Modeling habitat of the desert tortoise (Gopherus agassizii) *in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102. 18 p.*